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UNUSUAL OUTBURSTING STATE OF A Z CAM-TYPE STAR HL CMA

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HL CMa is well-renowned dwarf nova which was discovered as an Einstein X-ray source (Fuhrmann 1980; Chlebowski et al. 1981; Bailey et al. 1981; Meinunger 1981). Although the possible Z Cam-type nature had long been suggested (cf. Mansperger et al. 1994), the exact classification of the object required more than a decade until the detection of an unmistakable long standstill in 1999 (Watanabe et al. 2000). Several authors reported relatively unusual spectroscopic features in HL CMa (e.g. Wargau et al. 1983). Although later observations could not confirm the result (Cropper 1986), there was even a claim of the possible presence of circular polarization (Chlebowski et al. 1981). The object was thus intensively observed, particularly in the ultraviolet (Bonnet-Bidaud et al. 1982; Mauche, Raymond 1987a,b), which revealed the presence of significant outflow. Still et al. (1999) further studied the system, and obtained an orbital period of 0.2146 or 0.2212 d. In spite of relatively rich observations in the past, no spectroscopic observation during standstills has been reported, presumably because of the rarity of standstills.

The typical outburst cycle length of HL CMa is 15 d (cf. Chlebowski et al. 1981; see also Figure 1). During standstills, this outburst pattern disappears (Figure 2) as in other Z Cam stars (cf. Warner 1995).

In 2001–2002, we noticed the presence of "the third" outbursting state (Figure 3). During this period, the star showed weak (∼1 mag) outbursts with a longer (∼30 d) outburst cycle length. The outburst amplitude was intermediate between that of normally outbursting state (Figure 1) and nearly zero during standstills (Figure 2). Although the decrease of the outburst amplitude could be a result of an increased mass-transfer rate, the lengthening of the cycle length is quite unexpected, because an increase of mass-transfer rate generally leads to a shortening of the cycle length (e.g. Cannizzo et al. 1988, in which HL CMa was listed as an object already close to the instability border).

Such behavior may be compared to an unusual slow fading of a standstill in another Z Cam-type star AT Cnc (Kato et al. 2001). Kato et al. (2001) proposed that this behavior may be a combined result of heating on the accretion disk at an accretion rate slightly below the stability, analogous to fadings of VY Scl-type stars (Leach et al. 1999). The presence of strong P Cyg feature in the ultraviolet (Bonnet-Bidaud et al. 1982; Mauche, Raymond 1987a) and the unusual presence of high-excitation optical lines (Wargau et al. 1983; Chlebowski et al. 1981) could be interpreted as an emerging signature of strong

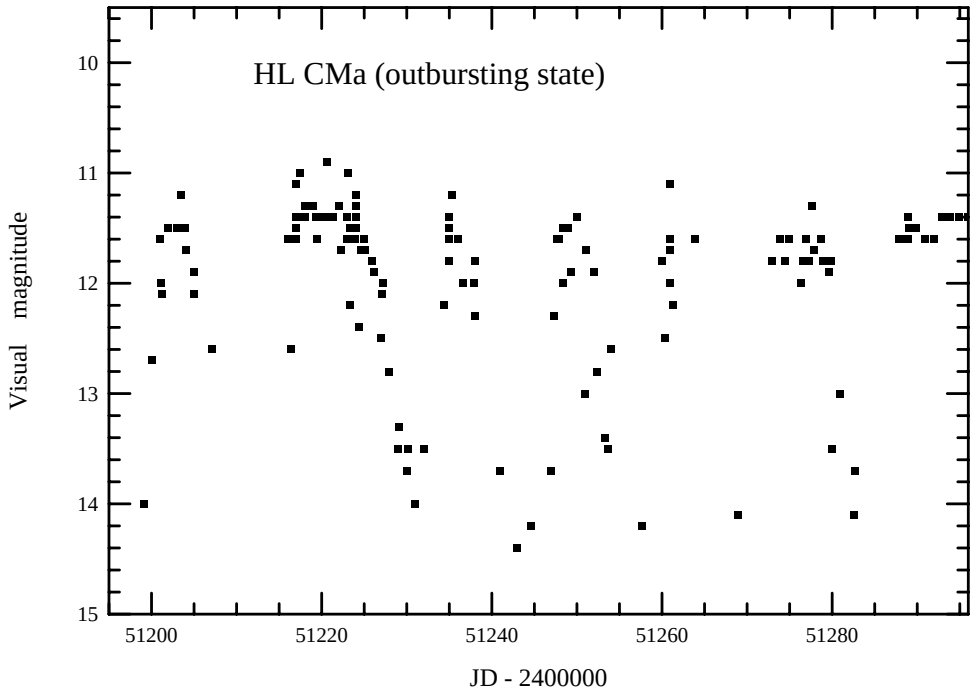

Figure 1. HL CMa in normally outbursting state. The data are from visual observations reported to VSNET (http://www.kusastro.kyoto-u.ac.jp/vsnet/). The errors of visual observations are usually less than 0.5 mag, which do not affect the discussion. Outbursts recur every ∼15 d.

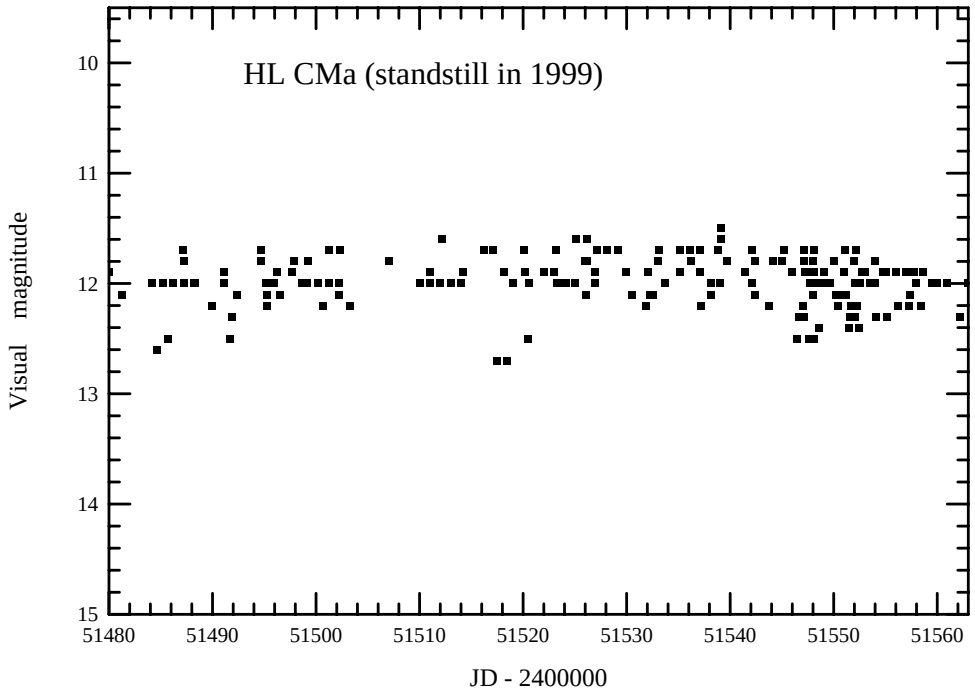

Figure 2. Representative light curve of the standstill of HL CMa in 1999 (data from VSNET). The star stopped outbursting.

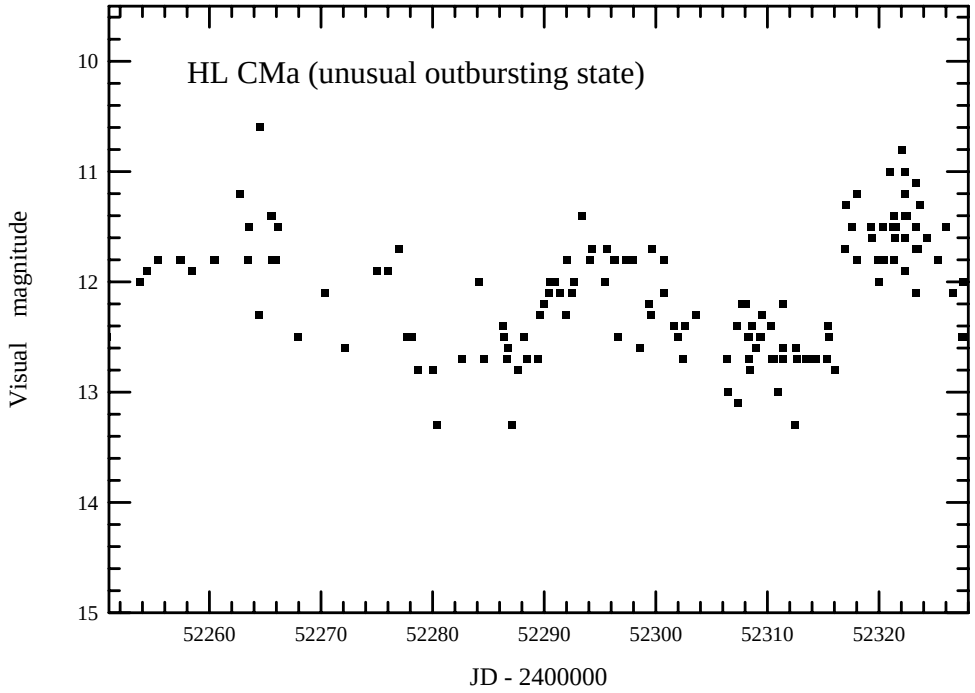

Figure 3. Light curve of "the third state" of HL CMa in 2001–2002. The star showed weak (∼1 mag) outbursts with a longer (∼30 d) outburst cycle length.

irradiation field. Since there have been only few occasions of unusually outbursting states in the decades-long history, X-ray and spectroscopic observations to detect further signatures of high-energy photons and irradiation are highly encouraged during the present unusual state.

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